PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

(Chapter II of the Patent Cooperation Treaty)

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference PD030120	**FOR FURTHER ACTION** See Form PCT/IPEA/416	
International application No. PCT/EP2004/010222	International filing date *(day/month/year)* 13.09.2004	Priority date *(day/month/year)* 11.12.2003
International Patent Classification (IPC) or national classification and IPC G11B20/00, H04H1/00		
Applicant THOMSON LICENSING S.A. et al		

1. This report is the international preliminary examination report, established by this International Preliminary Examining Authority under Article 35 and transmitted to the applicant according to Article 36.
2. This REPORT consists of a total of 7 sheets, including this cover sheet.
3. This report is also accompanied by ANNEXES, comprising:
   a. ☒ *sent to the applicant and to the International Bureau)* a total of 6 sheets, as follows:
      ☒ sheets of the description, claims and/or drawings which have been amended and are the basis of this report and/or sheets containing rectifications authorized by this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions).
      ☐ sheets which supersede earlier sheets, but which this Authority considers contain an amendment that goes beyond the disclosure in the international application as filed, as indicated in item 4 of Box No. I and the Supplemental Box.
   b. ☐ *(sent to the International Bureau only)* a total of (indicate type and number of electronic carrier(s)) , containing a sequence listing and/or tables related thereto, in computer readable form only, as indicated in the Supplemental Box Relating to Sequence Listing (see Section 802 of the Administrative Instructions).

4. This report contains indications relating to the following items:

☒	Box No. I	Basis of the opinion
☐	Box No. II	Priority
☐	Box No. III	Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
☐	Box No. IV	Lack of unity of invention
☒	Box No. V	Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
☐	Box No. VI	Certain documents cited
☐	Box No. VII	Certain defects in the international application
☐	Box No. VIII	Certain observations on the international application

Date of submission of the demand	Date of completion of this report
07.10.2005	11.11.2005
Name and mailing address of the international preliminary examining authority: European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465	Authorized Officer Willems, B Telephone No. +49 89 2399-8954

INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

International application No.
PCT/EP2004/010222

Box No. I Basis of the report

1. With regard to the **language**, this report is based on the international application in the language in which it was filed, unless otherwise indicated under this item.

   ☐ This report is based on translations from the original language into the following language , which is the language of a translation furnished for the purposes of:
   - ☐ international search (under Rules 12.3 and 23.1(b))
   - ☐ publication of the international application (under Rule 12.4)
   - ☐ international preliminary examination (under Rules 55.2 and/or 55.3)

2. With regard to the **elements*** of the international application, this report is based on *(replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report)*:

Description, Pages	
1-14	as originally filed
Claims, Numbers	
1-8	filed with telefax on 07.10.2005
Drawings, Sheets	
1/3-3/3	as originally filed

   ☐ a sequence listing and/or any related table(s) - see Supplemental Box Relating to Sequence Listing

3. ☐ The amendments have resulted in the cancellation of:
   - ☐ the description, pages
   - ☐ the claims, Nos.
   - ☐ the drawings, sheets/figs
   - ☐ the sequence listing *(specify)*:
   - ☐ any table(s) related to sequence listing *(specify)*:

4. ☐ This report has been established as if (some of) the amendments annexed to this report and listed below had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).
   - ☐ the description, pages
   - ☐ the claims, Nos.
   - ☐ the drawings, sheets/figs
   - ☐ the sequence listing *(specify)*:
   - ☐ any table(s) related to sequence listing *(specify)*:

* *If item 4 applies, some or all of these sheets may be marked "superseded."*

Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes:	Claims	1-8
	No:	Claims	
Inventive step (IS)	Yes:	Claims	
	No:	Claims	1-8
Industrial applicability (IA)	Yes:	Claims	1-8
	No:	Claims	

2. Citations and explanations (Rule 70.7):

see separate sheet

Re Item V

Reasoned statement with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Reference is made to the following documents:

   D1 = US-A-5 937 000

   D2 = US-A-5 687 191

   D3 = LOBOGUERRERO ET AL: 'Iterative Informed Audio Data Hiding Scheme Using Optimal Filter' ICCT 2003, vol. 2, 9 - 11 April 2003, pages 1408-1411, XP009029945 Beijing

2. The subject-matter of claim 1 lacks an inventive step with respect to the combination of the disclosures of documents D1 and D2. Therefore, claim 1 does not meet the requirements of Articles 33(1) and 33(3) PCT.

   Document D1 discloses (see figures 11 and 13, and column 16, line 26 to column 17, line 48) a method for transmitting watermark bits using a spread spectrum, the method including the steps of:

   modulating said watermark data bits on N encoder pseudo-noise sequence (286, 296, 306);

   spectral shaping the combined spread spectrum signals in an LPC synthesis filter to simulate the spectral shape of the primary data (column 17, lines 20 to 23);

   combining the watermark signal with the audio signal (column 17, lines 23 to 25); and

   transmitting the combined signal (see figure 13).

The PN generators can all operate at the same or different rates. If all PN generators operate at the same rate, than their PN sequences will preferably all be orthogonal with respect to each other to facilitate distinguishing the different input data streams at the decoder (column 16, lines 58 to 65).

It is clear from figure 11 of Document D1 that different signals modulated with orthogonal PN-sequences (280, 290, 300) are combined with one audio stream (260).

The subject-matter of claim 1 differs from the disclosure of Document D1 in that it specifies frequency and inverse frequency domain transformations and in that the claim specifies that the length of each pseudo-noise sequence is one N^{th} of the length of a frame of said audio signal.

However, Document D1 refers to spectral shaping. Therefore, the claimed frequency transformations are implicitly known form Document D1.

Further, it is well known to insert different parts(s) of the watermark(s) into different parts of the audio signal (see, for instance Document D2). The skilled person would inevitably try to provide said feature in the method known from Document D1. It is obvious to the skilled person that this requires adjusting the length of the PN sequences.

Thus, the subject-matter of claim 1 is rendered obvious by the disclosures of documents D1 and D2.

3. The subject-matter of claim 2 lacks an inventive step with respect to the combination of the disclosures of documents D1 and D3. Therefore, claim 2 does not meet the requirements of Articles 33(1) and 33(3) PCT.

Document D1 discloses (figure 12) a method for regaining watermark data bits embedded in a spread spectrum comprising the steps of receiving the combined audio and watermark signal and extracting the watermark signals using N orthogonal

pseudo-noise sequences.

The subject-matter of claim 2 differs from the disclosure of Document D1 in that the former specifies convolving corresponding sections of the audio signal with the time-inversed versions of the N orthogonal pseudo-noise sequences and determining from the signs of the peaks of the convolution results the value of the watermark data bits.

However, Document D3, page 1409 discloses an optimal detection method for spread spectrum watermarks. The method comprises the steps of convolving the received signal with the time-inversed version of the spreading sequence and determining from the signs of the peaks of the convolution results the value of the watermark data bits (see formula (4)).The examining division is of the opinion that the skilled person would inevitably try to substitute the despreading and demodulation in each of the branches of figure 12 with the optimal detection known from Document D3 using the respective pseudo-noise sequences.

Thus, the subject-matter of claim 2 is rendered obvious by the disclosures of documents D1 and D3.

4. The subject-matter of claim 3 lacks an inventive step with respect to the combination of the disclosures of Documents D1 and D3. Therefore, claim 3 does not meet the requirements of Articles 33(1) and 33(3) PCT.

Document D3 discloses an optimal detection method for spread spectrum watermarks comprising the steps of of convolving the received signal with the time-inversed version of the spreading sequence and determining from the signs of the peaks of the convolution results the value of the watermark data bits (see formula (4)).

The subject-matter of claim 3 differs from the disclosure of Document D3 in that the former further specifies combining time-shifted versions of the pseudo-noise orthogonal sequences to construct a modified decoder sequence.

However, the construction of the modified sequence is normal design procedure to compensate for echo delays.

It is obvious to the skilled person that compensation for echoes is also necessary when using multiple orthogonal sequences. Further, reference is made to the objections raised against claim 2.

Thus, the subject-matter of claim 3 is rendered obvious by the disclosures of Documents D1 and D3.

5. The subject-matter of claim 4 lacks an inventive step with respect to the combination of the disclosures of documents D1 and D3. Therefore, claim 4 does not meet the requirements of Articles 33(1) and 33(3) PCT.

Claim 4 further specifies an obvious detail of the processing of the echo delays.

5. The subject-matter of claims 5 to 8 lacks an inventive step with respect to cited prior art. Therefore, claims 5 to 8 do not meet the requirements of Articles 33(1) and 33(3) PCT.

Claims 5 to 8 specify apparatuses comprising features corresponding to the method steps of claims 1 to 4, respectively. Therefore, claims 5 to 8 are objected to for the reasons set out above.

Claims

1. Method for transmitting watermark data bits (IWATD) using a spread spectrum, said method including the steps:
- modulating (BVMOD) said watermark data bits on an encoder pseudo-noise sequence (ENCPNSEQ);
- transforming (WATSE) said modulated encoder pseudo-noise sequence (WATS) into the frequency domain and shaping it in amplitude according to the masking level curve of an audio signal together with which the watermark data bit information is to be transmitted or transferred, and transforming (WATSE) said shaped encoder pseudo-noise frequency domain sequence back into the time domain;
- combining (WATSE) said inverse transformed encoder pseudo-noise frequency domain sequence with a current frame of data of said audio signal, wherein the length of said encoder pseudo-noise sequence (ENCPNSEQ) is one Nth of the length of said audio signal frame, N being an integer number greater one, and wherein N orthogonal encoder pseudo-noise sequences (ENCPNSEQ) are used per audio signal frame for carrying out said combining for corresponding sections of said current frame;
- transmitting or transferring (TRM) said combined current audio signal frame carrying said watermark data bits.

2. Method for regaining watermark data bits (IWATD) embedded in a spread spectrum, whereby the corresponding original watermark data bits were modulated (BVMOD) at encoder side on an encoder pseudo-noise sequence (ENCPNSEQ) and said modulated encoder pseudo-noise sequence (WATS) was transformed (WATSE) into the frequency domain and shaped in amplitude according to the masking level curve (PSYMC) of an audio signal together with which the watermark data bit information was transmitted or transferred (TRM), and said shaped encoder pseudo-noise frequency domain sequence was transformed (WATSE) back into the time domain

and was combined with a current frame of data of said audio signal, wherein the length of said encoder pseudo-noise sequence (ENCPNSEQ) was one Nth of the length of said audio signal frame, N being an integer number greater one, and wherein N orthogonal encoder pseudo-noise sequences (ENCPNSEQ) were used per audio signal frame for carrying out said combining for corresponding sections of said current frame,
said method including the steps:

- receiving (REC, SYNC) and synchronising said transmitted or transferred audio signal;
- convolving (DRECMF) each one of a corresponding section of said current frame of data of said audio signal with the corresponding one of time-inversed versions (DECPNSEQ) of the N orthogonal encoder pseudo-noise sequences;
- determining (DRECMF), for each one of said sections, from the sign of the peak or peaks of the corresponding convolution result the value of a bit of said watermark data (OWATD).

3. Method for regaining watermark data bits (IWATD) embedded in a spread spectrum, whereby the corresponding original watermark data bits were modulated (BVMOD) at encoder side on an encoder pseudo-noise sequence (ENCPNSEQ) and said modulated encoder pseudo-noise sequence (WATS) was transformed (WATSE) into the frequency domain and shaped in amplitude according to the masking level curve (PSYMC) of an audio signal together with which the watermark data bit information was transmitted or transferred (TRM), and said shaped encoder pseudo-noise frequency domain sequence was transformed (WATSE) back into the time domain and was combined with a current frame of data of said audio signal, wherein the length of said encoder pseudo-noise sequence (ENCPNSEQ) was one Nth of the length of said audio signal frame, N being an integer number

greater one, and wherein N orthogonal encoder pseudo-noise sequences (ENCPNSEQ) were used per audio signal frame for carrying out said combining for corresponding sections of said current frame,

said method including the steps:

- receiving (REC, SYNC) and synchronising said transmitted or transferred audio signal;
- determining (EDET) in the received audio signal one or more echoes and the related echo delays;
- assembling together the N time-inversed versions of said orthogonal encoder pseudo-noise sequences (ENCPNSEQ) for a current frame and constructing a modified decoder pseudo-noise sequence (MDECPNSEQ) based on the time-inversed version of said encoder pseudo-noise sequence (ENCPNSEQ) whereby, according to the echo delay or delays determined, correspondingly time-shifted versions of said time-inversed encoder pseudo-noise sequence are combined in order to construct said modified decoder pseudo-noise sequence;
- convolving (DRECMF) each one of a corresponding section of said current audio signal frame with the corresponding section of said modified decoder pseudo-noise sequence (MDECPNSEQ);
- determining (DRECMF), for each one of said sections, from the sign of the peak or peaks of the corresponding convolution result the value of a bit of said watermark data (OWATD).

4. Method according to claim 3 wherein, when determining (EDET) in the received audio signal one or more echoes and the related echo delays, the results for several audio frames are evaluated before a final result on the echo delay is formed.

5. Apparatus for transmitting watermark data bits (IWATD) using a spread spectrum, said apparatus including:

- means (BVMOD) for modulating said watermark data bits on an encoder pseudo-noise sequence (ENCPNSEQ);
- means (WATSE) for transforming said modulated encoder pseudo-noise sequence (WATS) into the frequency domain and for shaping it in amplitude according to the masking level curve of an audio signal together with which the watermark data bit information is to be transmitted or transferred, and for transforming said shaped encoder pseudo-noise frequency domain sequence back into the time domain;
- means (WATSE) for combining said inverse transformed encoder pseudo-noise frequency domain sequence with a current frame of data of said audio signal, wherein the length of said encoder pseudo-noise sequence (ENCPNSEQ) is one Nth of the length of said audio signal frame, N being an integer number greater one, and wherein N orthogonal encoder pseudo-noise sequences (ENCPNSEQ) are used per audio signal frame for carrying out said combining for corresponding sections of said current frame;
- means (TRM) for transmitting or transferring said combined audio signal frame or frames carrying said watermark data bits.

6. Apparatus for regaining watermark data bits (IWATD) embedded in a spread spectrum, whereby the corresponding original watermark data bits were modulated (BVMOD) at encoder side on an encoder pseudo-noise sequence (ENCPNSEQ) and said modulated encoder pseudo-noise sequence (WATS) was transformed (WATSE) into the frequency domain and shaped in amplitude according to the masking level curve (PSYMC) of an audio signal together with which the watermark data bit information was transmitted or transferred (TRM), and said shaped encoder pseudo-noise frequency domain sequence was transformed (WATSE) back into the time domain and was combined with a current frame of data of said audio signal, wherein the length of

said encoder pseudo-noise sequence (ENCPNSEQ) was one Nth of the length of said audio signal frame, N being an integer number greater one, and wherein N orthogonal encoder pseudo-noise sequences (ENCPNSEQ) were used per audio signal frame for carrying out said combining for corresponding sections of said current frame,
said apparatus including:

- means (REC, SYNC) for receiving and synchronising said transmitted or transferred audio signal;
- means (DRECMF) for convolving each one of a corresponding section of said current frame of data of said audio signal with the corresponding one of time-inversed versions (DECPNSEQ) of the N orthogonal encoder pseudo-noise sequences, and for determining, for each one of said sections, from the sign of the peak or peaks of the corresponding convolution result the value of a bit of said watermark data (OWATD).

7. Apparatus for regaining watermark data bits (IWATD) embedded in a spread spectrum, whereby the corresponding original watermark data bits were modulated (BVMOD) at encoder side on an encoder pseudo-noise sequence (ENCPNSEQ) and said modulated encoder pseudo-noise sequence (WATS) was transformed (WATSE) into the frequency domain and shaped in amplitude according to the masking level curve (PSYMC) of an audio signal together with which the watermark data bit information was transmitted or transferred (TRM), and said shaped encoder pseudo-noise frequency domain sequence was transformed (WATSE) back into the time domain and was combined with a current frame of data of said audio signal, wherein the length of said encoder pseudo-noise sequence (ENCPNSEQ) was one Nth of the length of said audio signal frame, N being an integer number greater one, and wherein N orthogonal encoder pseudo-noise sequences (ENCPNSEQ) were used per audio signal frame for carrying out said combining for cor-

responding sections of said current frame
said apparatus including:

- means (REC, SYNC) for receiving and synchronising said transmitted or transferred audio signal;
- means (EDET) for determining in the received audio signal one or more echoes and the related echo delays, and for assembling together the N time-inversed versions of said orthogonal encoder pseudo-noise sequences (ENCPNSEQ) for a current frame and for constructing a modified decoder pseudo-noise sequence (MDECPNSEQ) based on the time-inversed version of said encoder pseudo-noise sequence (ENCPNSEQ) whereby, according to the echo delay or delays determined, correspondingly time-shifted versions of said time-inversed encoder pseudo-noise sequence are combined in order to construct said modified decoder pseudo-noise sequence;
- means (DRECMF) for convolving said current frame of data of said audio signal with said modified decoder pseudo-noise sequence (MDECPNSEQ), and for determining, for each one of said sections, from the sign of the peak or peaks of the corresponding convolution result the value of a bit of said watermark data (OWATD).

8. Apparatus according to claim 7 wherein, in said determining means (EDET), in the received audio signal one or more echoes and the related echo delays, the results for several audio frames are evaluated before a final result on the echo delay is formed.